Dynamics of Expectation Formation, a Microdata Study of Company Expectations from Business Surveys; Part II Second draft April 2005

Discussion paper 07007

[1]*Floris van Ruth*

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Explanation of symbols

.	= data not available
*	= provisional figure
x	= publication prohibited (confidential figure)
–	= nil or less than half of unit concerned
0 (0,0)	= less than half of unit concerned
–	= (between two figures) inclusive
blank	= not applicable
2005?2006	= 2005 to 2006 inclusive
2005/2006	= average of 2005 up to and including 2006
2005/'06	= crop year, financial year, school year etc. beginning in 2005 and ending in 2006
2003/'04?2005/'06	= crop year, financial year, etc. 2003/'04 to 2005/'06 inclusive

Due to rounding, some totals may not correspond with the sum of the separate figures.

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Summary: *In this study a dataset containing business survey variables and actual turnover realizations at the firm level is used to study what influences firms' production expectations, what causes these to change and to test a number of hypothesis on expectation formation.*

It was found that there is a strong positive relation between expected production, order inflow and expected price changes. Expectations seem to be more influenced by general business conditions, as characterized by for example orders and prices, than by short-term developments in turnover realizations. A change in expected production was likely to be accompanied by a contemporaneous change in order inflow, price expectations, the assessment of the level of stocks and the assessment of current production. Errors in expectations in the previous month were of influence as well. It was also shown that although they are strongly influenced by past realizations, expectations also contain a strong forward looking component. Exogenous information, like macro-economic news, was of little influence on individual firms' expectations and added little to turnover predictions. These results support the use of Business Survey data in business cycle analysis and forecasting.

None of the tested expectation formation mechanisms could give a good description of actual expectations. Rational expectations were rejected as expectations were neither unbiased nor efficient. Extrapolative and adaptive expectations could not be rejected, but these cannot account for the forward looking component in expectations. Interestingly, error-learning did seem to be present.

Keywords: Business Survey, production expectations, forecasting, micro-data, Expectations formation, Rational expectations, bounded rationality, adaptive expectations, adaptive expectations, business cycle analysis, error-learning.

1. Introduction

Expectations play an important role in economic theory. Expectations of the future influence current behavior, and influences the way people react to economic policy. It is therefore quite important to know how expectations are formed, what influences them and whether this corresponds to the theoretical models. In this paper, a study will be made of the production expectations from the Dutch Manufacturing Business Survey, using data at the firm level. The focus in this study will be on testing several expectations formation mechanisms and analyzing the dynamics of Survey Expectations. The dataset used here offers an unique opportunity to do this, as expectations are coupled at the firm level to actual turnover realizations.

A very influential and important mechanism is that of rational expectations, for which expectations have to meet stringent requirements. Especially the forward-looking character is important. The validity of this mechanism is tested here, as well of a number of other proposed expectation formation mechanisms. Apart from this, it is sometimes said that expectations are more determined by the past than by the future, or are heavily influenced by external news in stead of actual business conditions. To give a more solid base for the use of Survey variables in economic analysis, it is important to address these questions.

A number of studies have used aggregate survey data, both for consumers and for firms, to address these questions. Only a few have been able to use the micro-data, which allows the researcher to study expectations of individual agents. In order to assess the quality of expectations, it is necessary for realizations to be available against which to test the expectations. The dataset available for this study means that expectations can be confronted with the corresponding actual realizations. Expectations were compared to different measures of turnover development, both short- and medium-term, as these exhibit quite different behavior. Due to the qualitative nature of the Survey data, in all cases the logit-model was used to perform the tests. It turns out that expectations are highly complex, being both forward- and backward-looking, possessing a seasonal pattern but also a strong component linked to the business cycle.

The first part of this study gives a short description of the relevant theory, with a survey of some relevant results from literature. Then the dataset and the variables used are described. The results are divided into three parts; first it is tested how well the different expectation formation mechanisms describe the data. The next section studies how the other components of the Business Survey interact with production expectations and what the influence is of external information, or “news”. The final section is about changes in expectations, whether these are caused by previous errors in expectations or changes in turnover or business conditions.

2. Background

Business surveys are mainly of interest for two reasons. Firstly, Survey outcomes are frequently used in evaluating the direction of economic developments, in business cycle analyses and in economic forecasting. It is therefore important to study what aspects of business conditions these Survey outcomes actually represent and with what accuracy. Business Surveys are relevant to economic theory as well. An important part of most surveys concerns firms' expectations of future developments and their own future actions. Expectations like these play an important part in most modern macro-economic theories. The way expectations are formed, and their quality is therefore of great importance. For example, the rational expectations hypothesis has been of great influence in macro-economic theory, but highly disputed as well [Holden et al.(1985)]. This section will review some of the theoretical background of expectations, and some empirical evidence on the nature and quality of survey outcomes, both of firms and consumers.

I will start with a short review of the main expectation formation processes as proposed in literature. Two usually mentioned basic mechanisms are adaptive expectations and extrapolative expectations. In the adaptive expectations case, expectations are influenced by past deviations of realisations from expectations (the notation used in this study links the expectations a time t with future realisations at t+i, in this case the expectations at t $X^*_{t+1|t}$ correspond to the realisations at t+1 X_{t+1}):

$$1.\ X^*_{t+1|t} = \lambda X^*_{t|t-1} + (1-\lambda)(X^*_{t|t-1} - X_t) + \varepsilon_t$$

Alternatively, in the extrapolative expectations case, the expectations are solely based on past realisations:

$$2.\ X^*_{t+1|t} = \sum_{i=0}^{T} \beta_i X_{t-i} + \varepsilon_t$$

These two mechanisms are essentially backward looking, and have therefore attracted criticism. A lot of information is ignored when forming expectations like this. The theory of rational expectations (RE) [Muth(1961)], the paramount theory of expectation formation in economics for the past three decades, was developed partly to remedy this. It describes expectations as essentially forward looking, optimising and containing all relevant information. Agents are supposed to use all information available to them in an efficient manner when forming expectations. This means that expectations cannot be systematically wrong and cannot be readily improved upon.

Thus, the RE expectation X^*_{t-1} of some quantity X_t is the best possible prediction a time t-1:

$$X^*_{t|t-1} = E_{t-1}(X_t) = X_t + \varepsilon_t$$

With ε_t uncorrelated and mean 0.

This hypothesis imposes a number of strong restrictions on the expectations, which can be used to test its validity. The first condition is that of unbiasedness:

3a. $X_{t+1} = \alpha + \beta X^*_{t+1|t} + \varepsilon_t$

with $\alpha=0$, $\beta=1$ and ε_t a white noise process. Or in alternative formulation[Zimmermann(1986)]:

3b. $X_{t+1} - X^*_{t+1|t} = \alpha + \beta X^*_{t+1|t} + \varepsilon_t$

with $\alpha=\beta=0$.

In effect, this means that expectations cannot deviate systematically from the realisations. The second condition is that of efficiency, all information contained in the past realisations of X_{t+1} should be contained in the expectations $X^*_{t+1|t}$. Therefore, the errors in expectations should be independent of past realisations.

4. $X_{t+1} - X^*_{t+1|t} = \alpha + \sum_{i=0}^{T} \beta_i X_{t-i} + \varepsilon_t$

with $\alpha = \beta_i = 0$.

The last condition, orthogonality, is an elaboration of the efficiency condition. It states that the expectations $X^*_{t+1|t}$ should be the best available prediction of X_{t+1} available at time t.

5. $X_{t+1} - X^*_{t+1|t} = \alpha + \sum_{i=0}^{T} \beta_i I_{t-i} + \varepsilon_t$

with $\alpha = \beta_i = 0$.

Where I_t is the information set available at time t.

This last condition states that all, readily available, relevant information at the time of expectation formation is included in the process, and can therefore not be used to improve the predictions.

The rational expectations hypothesis sets very high standards for the expectations formations process. It has been argued that the demands made on economic agents are unrealistic[Holden et al.(1985), Kowalski(2002)]. One of the main criticisms levelled against RE is the cost, in time and money, and difficulty of gathering and analyzing all relevant information. It was suggested that economic agents are better described by bounded rationality[Kowalski(2002), Evans and Honkapohja(2001)] This takes into account the fact that information is often unavailable and incomplete, and that processing and analysis capacity is limited. Agents are described as making an assessment of the cost and benefits of gathering further information. One way of making this theory operational is by assuming that agents use simple methods for making predictions when information is scarce or expensive. A few possibilities are listed below.

- Simple rules of thumb: for example, if in the last period turnover declined, this period it will decline/increase
- Simple forecasting tools: for example simple AR models.
- Experience: the expected realisation will equal the average of the past n realisations.

A number of studies have tried to assess the nature of the expectation formation mechanism and to test the rational expectations hypothesis using survey data, both of firms and consumers. Some of these were able to use micro data as well, others used macro-aggregates. A well-known problem arises that this could be a dual hypothesis test; testing both whether expectations conform to the proposed mechanism, and whether survey data represent actual expectations. A rejection of a hypothesis can thus either mean that expectations do not conform to the proposed mechanism, or that the data used do not accurately represent expectations. As the Survey participants are explicitly asked for their expectations, it is usually assumed that on average the answers at least closely resemble expectations. As long as no systematic bias is present between expectations and survey answers, this is a justifiable assumption.

Zimmermann (1986) used a set of micro-data from the German IFO-survey, to test qualitative expectations to the qualitative realisations of the same survey. His results firmly reject the rational expectations hypothesis, though he makes a number of qualifying remarks. Both unbiasedness and efficiency are rejected. A similar exercise was performed in a Statistics Netherlands study [Ekker (1983)], using a rather short sample of micro data from the Dutch Manufacturing Business Survey. It was found that neither adaptive expectations, extrapolative expectations, nor rational expectations offered a good description of the data. Efficiency of expectations was

rejected as the new orders component of the Survey was shown to possess more information on future realisations that the expectations component. A study of British CBI micro-data [Low et al(1990)] also casts doubt on the rationality of firms' expectations. But they also show that both production expectations and pricing plans are significantly determined by demand expectations. Tests of rationality of expectations have also been performed using micro data from American consumer surveys. Benitez-Silva et al.(2003) test the rationality of retirement and educational attainment expectations. They use two surveys which followed respondents over a longer period of time, and find that their expectations pass the rationality tests. The study of Soules (2001) on the other hand rejects the rationality hypothesis for consumer expectations. Expectations are confronted with realisations by combining micro-data from two different surveys, one on expenditures and one on expectations. Expectations are found to be biased, generally underestimating the realisations, and inefficient. On the other hand, expectations were found to be significant in forecasting consumption expenditures, even after controlling for lagged consumption and other relevant macro-economic variables.

Aggregate macro-data have also been used to study the quality of expectations. Mayers and Mors (1990) use different econometric models and the Kalman filter to evaluate how expectations react to new information. From the BCI-survey, expectations of new orders and employment were selected. They show that expectations can be satisfactorily modelled as random walks with drift or simple autoregressive processes. In the confrontation with realisations for new orders, simple random walk models or autoregressive ones yield better predictions than expectations. The overall conclusion is that firms do not respond adequately to new information. Temporary shocks tend to be interpreted as permanent changes, whilst permanent changes are only gradually recognised. Overall, firms seem to depend too much on prior beliefs, resulting in systematic errors. Holden et al. summarise a number of macro studies, both of consumer expectations and business expectations of various countries. For both types of expectations, rationality is almost always rejected. Adaptive and extrapolative expectations do not seem to fit the data much better. As far as the business survey data are concerned, again unbiasedness and efficiency are generally rejected. Relatively simple ARIMA models outperform expectations and readily available macro-economic information can improve the expectations.

These previous results seem to bode ill for the value of Business Surveys. However, they are mainly tests of expectations against a few fairly restrictive models of expectation formation. The value of business surveys is more in business cycle analyses and economic forecasting. Quite a few studies have looked into this. Boehm (1993) analyses the usefulness of Business surveys in monitoring the business cycle for Australia and the UK. A clear relationship is found, though simple net balances exhibit numerous extra cycles. Several components of the survey were found to be leading the business cycle by as much as nine months. Hinchcliffe and Pritchard (1999) from the Australian bureau of statistics see a definite, though noisy relationship between expected changes from the business

expectations survey and the realisations for a number of major economic variables. Batchelor (1982) used expectations in the manufacturing industry in Belgium, Italy, France and Germany. He found that though models containing business survey data were not without merit, they performed worse than simple ARMA models. On the other hand, business surveys were uniformly best in predicting turning points, a very useful property.

In an accompanying study [Van Ruth (2006)], the same data as in this study were used to test the link between production expectations and turnover realisations. Several measures of turnover development were constructed, ranging from monthly month-on-month or year-on-year changes to average developments over a twelve-month period. Expectations were in almost all cases relatively poor predictors of turnover development, being outperformed by simple autoregressive models. However, when added to these autoregressive models, expectations did add significant new information, resulting in improved predictions. A central issue was whether expectations are more connected to turnover realisations in individual months or more to longer-term average development in turnover. It was shown that expectations reflect mainly average, longer-term, developments in turnover. The strongest link was with average turnover changes over a twelve-month period. Developments in turnover on this measure were strongly connected to the business cycle. This indicates that expectations are clearly influenced by changes in business conditions linked to the cycle.

3. Data description and considerations

Statistics Netherlands publishes both a monthly index of turnover in the manufacturing industry as well as a monthly Manufacturing Business Survey (MBS). Therefore, for both statistics data are available for individual firms, i.e. at micro level. Combining these datasets creates the opportunity to study the interaction between producer's expectations and actual realisations. A combined dataset coupled at firm-level was created containing turnover data for the period 1999-2003 and survey data for the period 2001-2003. The sample consists of 1852 firms.

The Manufacturing Business Survey (MBS) uses a relatively straightforward approach to get a quick impression of firm's assessment of their current situation, business conditions, and their expectations of the near future. About a quarter of firms in manufacturing industry are surveyed, once every month. Broadly speaking, two types of questions are asked; assessments of the current stance of some relevant quantity (normal, large, small), and expectations or tendency (increase/remain the same/decrease) of the development of some variable. For this study, a selection of the most relevant variables was made.

1. Assessment of the current level of production	$\mathbf{PA_{t\|t}}$
2. Expectation of the tendency of the level of production in the coming three months (compared to this month)	$\mathbf{PE_{t+i\|t}}$
3. Expected tendency of sales prices in the coming three months	$\mathbf{PRICE_t}$
4. tendency of the value new orders in the preceding month.	**OrderTenden**
5. Expected tendency of number of staff	**STAFF**
6. Assessment of the preceding months order inflow	**OrdersIn**
7. Assessment of the total value of current orders	**OrdersTotal**
8. Assessment of inventory level	**INVEN**

The main focus is on the expected tendency of production in the coming three months ($PE_{t+3|t}$), as this best reflects producers' expectations of the future, and is

therefore of the most theoretical and practical interest. The other survey questions are mainly included because of their potential influence on or interaction with production expectations, or because they might add information to the production expectations.

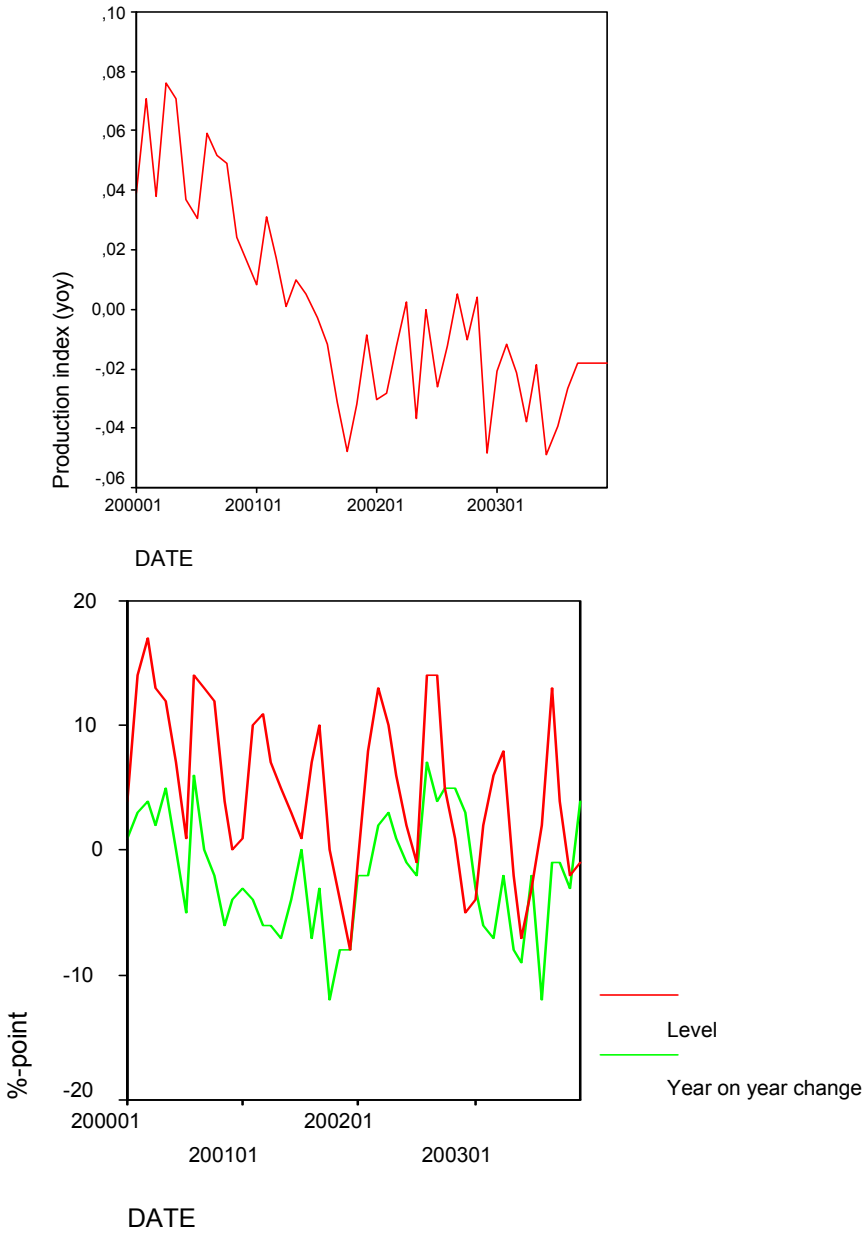
Note that these questions only result in qualitative answers, one of three possibilities "increase", "decrease" and "no change". For the published survey statistics, the percentage of firms reporting an increase is computed, as well as the percentage reporting an decrease, and the balance of these two percentages is the reported statistic. The fraction reporting no change is ignored. This last approach will be used in this study as well. Only cases where an increase or a decrease is reported are considered, as incorporating the "no change" category creates numerous difficulties. For a start, this eliminates those respondents who do away with the survey by always answering "remained the same".[see Nieuwstad (2004)] Furthermore, what range of turnover changes constitutes no change is very difficult to determine beforehand. Generally, it is assumed that turnover changes need to cross a certain threshold before an increase or decrease is reported. Techniques have been developed to derive these from the data [Mitchell et all.(2001), Pearsan (1984)] but these are somewhat cumbersome, and applying the computed thresholds to individual firms could be problematic. For the sake of simplicity therefore, all rises in realised turnover are categorized as "increase", and all other realisations as "decrease". For each turnover variable/survey question, a 0/1 dummy variable is created, with 0 indicating a "down"-answer, and 1 an "up"-answer.

In the turnover survey, firms are asked to report the value of goods and services billed to costumers this month. This poses two problems as far as the aim of this paper, investigating the relation between expectations and realisations, is concerned. Firstly, the business survey inquires into production expectations and realisations, whilst the turnover survey, of course, inquires after turnover. Price effects can cause production, defined by statisticians as a (deflated) volume quantity, and turnover to diverge. However, there are two reasons why I expect this not to be a great problem. The typical time span in the business survey is one to three months, a period in which for most industries price effects are probably not very important. Furthermore, even though asked about production, a producer's assessment of the state and direction of the business will probably be at least partly determined by the money value of production. For a start there is the possibility of monetary illusion. More importantly, the natural measures to assess the state of a business are turnover and profits, both monetary quantities. So as far as this is concerned, turnover is probably an acceptable proxy for the production measure used in the business survey. An explorative study at Statistic Netherlands [Nieuwstad (2004)] into the quality of Survey responses at the firm level found that on average 12.6% of firms always answered "remained the same" on the expectations question, irrespective of the actual realisations (in this case, month-on-month turnover changes). A further 27.5% gave answers which seemed to have no relationship to the realisations,

suggesting random completion of the survey. This still means that at least 60% of the response is meaningful.

Before reporting on the actual research, it is probably informative to describe the general developments in the Dutch industry in the period concerned. The period 2001-2003 was not a very prosperous one for the Dutch Industry. In 2000, the business cycle turned and a glide into recession commenced. This can be seen in the development of the Index of Industrial production over the period.

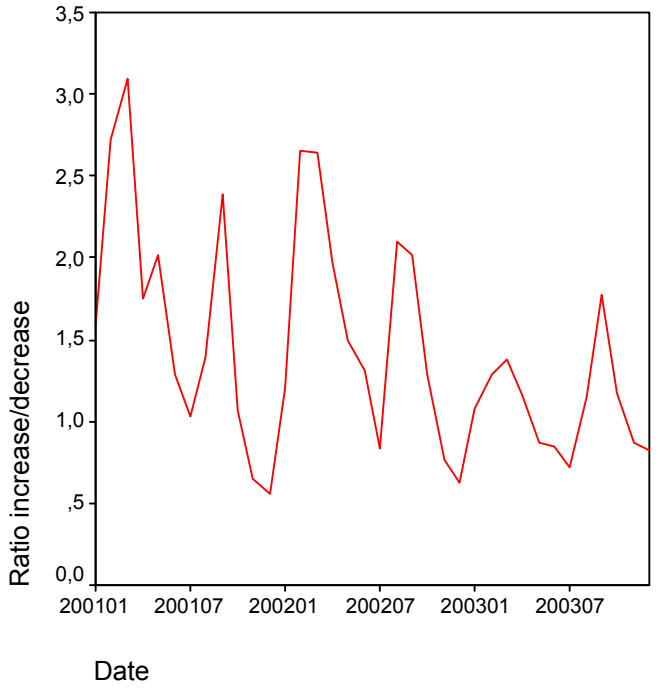
Graph 3.1; (a) Relative monthly year-on-year change in the manufacturing production index 2000-2003.(b) Manufacturing industry balance of opinion on production expectations concerning the coming three months, level and yoy-change.



From 2000 onwards conditions worsen, whilst in the second half of 2002 stabilisation in a state of shrinking production can be seen. This is also visible in the results of the Manufacturing Business Survey, for example in the balance of positive and negative production expectations (graph 3.1b). These show a general downward trend, though this is better visible in the values of the absolute year-on-year change. Halfway 2000, these turn negative and only in the beginning of 2002 a temporary recovery is visible. This corresponds quite well to the development in the index of industrial production in graph 3.1a.

Another way to look at this, and more relevant for this study, is to consider the ratio between firms answering "increase" vs. firms answering "decrease" in our (micro-) dataset, see graph 3.2.

Graph 3.2. Ratio of number of firms answering that production will increase in the coming three months to number of firms answering decrease.



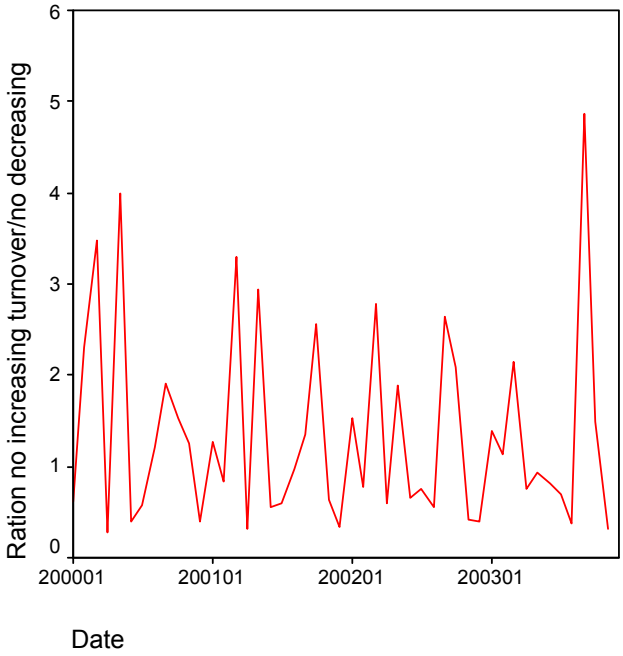
Besides a seasonal pattern, the ratio also exhibits a distinct downward trend , reflecting overall increasingly pessimistic expectations. It is important to note that in this study, the term "trend" is used somewhat loosely, indicating all developments with periods longer than seasonal. This includes both trend and cyclical components.

To determine how developments in turnover influence expectations and to address the concerns mentioned above, several different measures of firm turnover development were constructed. It is interesting to see whether these trends are reflected in these turnover measures. For the most relevant measures, the aggregate number of firms reporting a positive turnover realisation (>0) or a negative one were computed. The ratio of these two numbers was then determined and its development in time plotted. The first measure is the month-on-month change in turnover, which may be relevant as it is most directly observed by producers.

1. The relative month-on-month change in turnover

$$\left(turnover_t - turnover_{t-1}\right) \Big/ turnover_{t-1}$$

Graph 3.3; Ratio of number of firms reporting a positive month-on-month turnover change to number of firms reporting a negative one.



With some difficulty, a downward trend is just visible. It is only weakly present drowned out by random fluctuations and a strong seasonal pattern.

2. The relative year on year change in turnover

$$\left(turnover_t - turnover_{t-12}\right) \Big/ turnover_{t-12}$$

Firm's production expectations as surveyed in the MBS concern the development in the coming three months. Therefore a statistic was computed comparing the level of turnover in the current month t to the average turnover level in the coming three months:

3. The turnover in the current month compared to the average turnover in the coming three months.

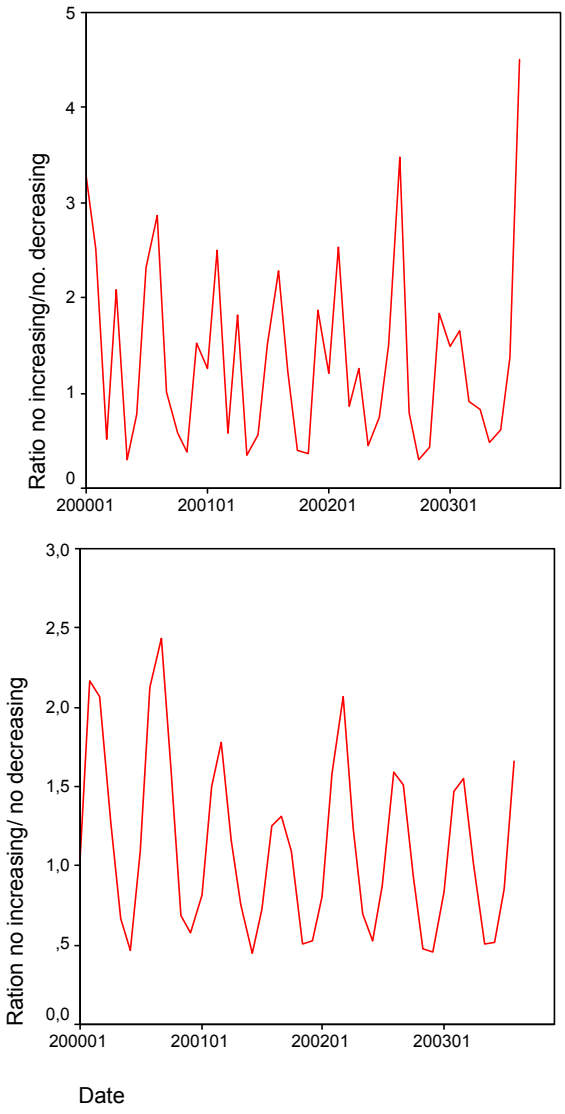
$$TOma3F_t = \left(\left(\left(\sum_{i=1}^{i=3} turnover_{t+i}\right) \Big/ 3\right) \Big/ turnover_t\right) - 1$$

The value which these statistics take depends for a large part on the value of the turnover in month t. Large fluctuations in single month turnover values can therefore cause large fluctuations in the computed three-month development, which may not be representative for the overall tendency of production. A remedy is to compare the turnover in the coming three months to the turnover in the last three months. This will smooth out the influence of irregular fluctuations, and also mitigate somewhat the problem of intermittent turnover bookings.

4. The turnover in the coming three months compared to the turnover in the past three months.

$$TOma3FL_t = \left(\frac{\sum_{i=1}^{i=3} turnover_{t+i}}{\left(\sum_{i=1}^{i=3} turnover_{t-i} \right)} \right) - 1$$

Graph 3.4; (a) Ratio of firms reporting an increase in the average turnover in the coming three months when compared to the turnover this month. (b) Ratio of firms reporting an increase in the turnover in the coming three months when compared to the turnover in the past three months.



No trends are visible in these measures of turnover development, though the aggregate production index clearly shows that over this period a downward trend is present in turnover. The first three-month turnover measure is rather noisy and seems to be dominated by seasonal effects. Comparing the coming three months turnover to the next three months' only slightly improves matters. Though more smooth, in this three-month turnover measure seasonal effects dominate as well. A complementary statistic is the development relative to the past three months:

5. The turnover in the current month compared to the average turnover in the past three months.

$$TOma3L_t = \left(turnover_t \Big/ \left(\left(\sum_{i=1}^{i=3} turnover_{t-i} \right) \Big/ 3 \right) \right) - 1$$

Comparing turnover in the coming three months to turnover in the past three months greatly reduced volatility. Longer term averages will be even more successful at this, while at the same time eliminating seasonal effects. Using one year averages would be ideal, but as the available dataset contains only three years of data, this would result in an unacceptable reduction of available observations. As a compromise, 6 month averages were computed. These statistics represent medium-term trends in turnover, and might therefore have a different relation to expectations than the one and three-month measures of turnover development.

6. The turnover in the current month compared to the average turnover in the coming six months.

$$TOma6F_t = \left(\left(\left(\sum_{i=1}^{i=6} turnover_{t+i} \right) \Big/ 6 \right) \Big/ turnover_t \right) - 1$$

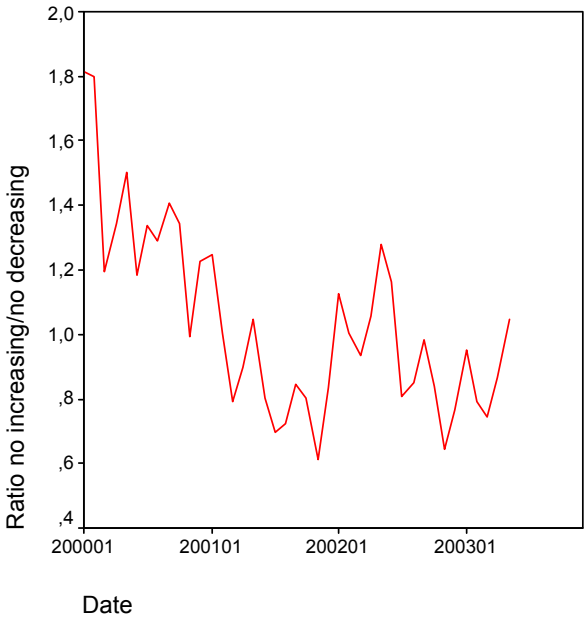
7. The turnover in the current month compared to the average turnover in the past six months.

$$TOma6L_t = \left(turnover_t \Big/ \left(\left(\sum_{i=1}^{i=6} turnover_{t-i} \right) \Big/ 6 \right) \right) - 1$$

8. The turnover in the coming six months compared to the turnover in the past six months.

$$TOma6FL_t = \left(\frac{\sum_{i=1}^{i=6} turnover_{t+i}}{\left(\sum_{i=1}^{i=6} turnover_{t-i} \right)} \right) - 1$$

Graph 3.5; Ratio of firms reporting an increase in the turnover in the coming six months when compared to the turnover in the past six month (TOma6FL)s.



The ratio of turnover in the coming six months to turnover in the last six months exhibits a clear downward trend, which corresponds nicely to the direction of developments in production expectations and in the index of industrial production in this period.

As a different approach to capturing longer-term trends in turnover, two multinomial categorical variables were created. These compare in the coming six months the number of months with declining turnover to the number of months with increasing turnover. Both month-on-month and year-on-year turnover changes were used.

9. noyoyF6 = number of months in coming 6 months with positive year-on-year changes in turnover – number of months with negative changes

10. nomomF6 = number of months in coming 6 months with positive month-on-month changes in turnover – number of months with negative changes

Lagged values of both statistics, for the past six months, were computed as well. These were named avnodyL6 and avnodpL6.

These two statistics are general, relatively long term measures of whether the developments are positive or disappointing. Unlike the previous statistics constructed to represent the longer-term developments, the changes in each month are given equal weight. In some cases, especially with sporadic large deliveries, this might result in an unrepresentative statistic. But in general they will probably be an interesting representation of each of the coming six months influence on the producer's expectations.

It should be noted that each of the statistics described here was when necessary transformed into a 1/0 binomial dummy variable, taking the value 0 if the original statistic was smaller than zero, and the value 1 for realisations larger than zero.

4. Results

4.1 Methodology

To formally test the significance and quality of the expectations, we will mainly use logit-models. The choice of statistical techniques arises from the nature of the data. Expectations, as defined here, are up/down binary variables. When these are entered as the dependent variable in a logit-model, a logarithmic transformation to obtain a continuous probability distribution is used (for details see Appendix 2). This allows the model to estimate the probability of obtaining a 1 or 0 value for the dependent variable as a function of the independent variables, at the same time testing the significance of the exogenous variables in explaining the observed values. A positive coefficient of an explanatory variable then means that a positive realisation of this variable will increase the probability of obtaining a "1" realisation for the dependent variable (here: an increase). The output of the model is a standardized probability. By convention, probabilities larger than 0.5 are assumed to translate to a value of 1 for the dependent, whilst values smaller than 0.5 result in a 0. This allows the output of the model to be compared to the 0/1 realisations. When using a turnover variable as dependent variable, it is of course not necessary to use a logit-model, as these are normal, continuous variables. But the aim here is not to predict a quantitative value for turnover, but to assess how well expectations predict turnover and which measure of turnover corresponds best with expectations. Therefore, it is more pure to transform the turnover variables into an up/down variable as well. When entered as a dependent variable, turnover change variables will be set to 1 if they are positive, and to 0 if they are negative. When used as exogenous variables, they will be entered in their normal, continuous mode.

A short note on the interpretation of the results. The nature of the logit-model and the different types of variables entered in the models makes it difficult to use the value of the estimated coefficients to determine the importance of the exogenous variables in explaining the dependent variable. Significances can be interpreted as in linear models, and generally the sign of the coefficient shows the direction of the relationship between exogenous and dependent variable. When evaluating the fit of a logit-model, generally the Chi-square statistic, in combination with the degrees of freedom, is used to compare the fit of different models. In this study, this will in general not be possible, as I will compare models with different dependent variables and different samples sizes due to differing patterns of missing values in the exogenous variables. Therefore, emphasis will be given to two other commonly employed methods for evaluating logit-models; Cox&Snell/Nagelkerke R^2 and the

percentage of observations correctly predicted. Models containing only a constant are used as a benchmark in this type of modelling. They will predict all ones or all zeros, of these usually the category which dominates the realisations. Constant only models are in fact a type of naïve prediction. In case of our expectation data, pessimism dominates with more expected decreases (0) than increases (1) in the sample. Therefore, the benchmark model predicts only zeros, thus obtaining the best fit possible with only a constant in the model. The fit of an estimated model can now be evaluated by comparing its overall percentage correct to that of the benchmark model, and also by evaluating how it improves the prediction of the minority realisation, in my example the ones. The Cox&Snell/Nagelkerke R^2 measures compare the likelihood of the estimated model to that of a model only containing a constant. They vary between 0 (no improvement) and 1 (perfect fit). For convenience, table 4.1 contains the codes for the different turnover variables entered as dependent variable with a short description.

Table 4.1; Description and codes of different measures of turnover development.

Exogenous variables	*All 0/1 (up/down) dummies*
TOma3FL	turnover change next 3 months compared to last 3
TOma6FL	turnover change next 6 months compared to last 6
noyoyF6	Number of months with yoy change >0 – Number of months with yoy change < 0 in coming 6 months
nomomF6	Number of months with m.o.m. change >0 – Number of months with m.o.m. change < 0 in coming 6 months
TOma3F	Average turnover coming 3 months compared to present month
TOma3L	Average turnover last 3 months compared to present month
TOma6F	Average turnover coming 6 months compared to present month
TOma6L	Average turnover last 6 months compared to present month
TOmom(t-1, t, t+1)	Month-on-month turnover change at different lags
TOyoy(t-1, t, t+1)	year-on-year turnover change at different lags

4.2 Expectation formation processes; formal tests.

Expectations play a central role in most modern economic theories. Therefore, and of course out of considerations of usefulness, their quality and the nature of the expectations formation process are of great interest. This section will focus on the nature of the expectation formation process, which will be done by testing the main processes as described in the literature (see section 2).

These proposed mechanisms were tested using our producers' expectations and realisations. The realisations used were those turnover measures which were best predicted by production expectations; the relative month-on-month turnover change TOmom, the turnover development from the past three months compared to the coming three months TOma3FL, and the same for the past and coming six months TOma6FL. Different measures of turnover development are used as it is not a priori clear what measure producers have in mind when reporting their expectations. Being too strict here will result in possible needless rejection of certain mechanisms.

Two types of variables measuring the deviations of realisations from expectations were constructed for each measure of turnover development. Prediction errors are given by a multinomial categorical variable with three values; -1 for under-prediction (pessimism), 0 for over-prediction (optimism) and 1 for a correct forecast. I chose to create and model two separate variables, as creating a single error-variable would probably result in difficulties in the modelling process. In the one variable case, a "1' would both represent over- and under prediction. The influence of potential explanatory variables can be quite different in both cases, warranting separate modelling in order to produce meaningful estimates. For test 3b (unbiasedness) however, a variable is constructed which is set to 1 for an incorrect prediction, and 0 otherwise. This allows equation 3b to be estimated, testing whether expectations are unduly pessimistic or optimistic. This is done by estimating a logit model with prediction errors as dependent variable and expectations as exogenous variable. Rationality implies that expectations will not be significant. For the expectations to be efficient (4), the prediction errors should be independent of lagged values of turnover realisations. This is tested in a model as well. Condition 5 (Orthogonality) is tested in two ways; the first one (5a) is by testing whether prediction errors are independent of a broad set of survey and exogenous variables. If not, this means that errors could be reduced if this information was applied efficiently. The second method (5b) builds on this, it tests whether next to expectations other (readily available) variables can be used to improve turnover predictions. If so, then the rational expectations hypothesis is violated.

The results will now be presented, grouped by the measure of turnover development against which the hypotheses are tested. First, the results for the adaptive and extrapolative mechanisms are shown, and then a brief summary of the results of the rational expectations tests. The complete results can be found in appendix A.

A. Testing expectation formation mechanisms assuming that the expectations correspond to the month-on-month change in turnover ($TOmom_t$):

1. adaptive	**$PE_{t+3\|t}$** R^2: 0.177/0.238		**2. extrapolative $PE_{t+3\|t}$**	R^2: 0.001/0.001	
χ^2 =1787(2)	% correct: 72.4		χ^2 =4.4(1)	% correct: 57.5	
Exogenous	Coefficient	Wald	Exogenous	Coefficient	Wald
C	1.159 (0.000)	1258.0	C	0.293 (0.000)	141.3
$TOmom_{t-1}$	-0.002 (0.000)	16.7	$TOmom_{t-1}$	0.001 (0.036)	4.4
$PE_{t\|t-1}$	1.911 (0.000)	1599.7			

The adaptive expectations mechanism clearly is a much better description of production expectations than extrapolative expectations. The overall fit according to the R^2-measures is much higher, as is the percentage of correct predictions. The better performance is completely due to the lagged expectations though.

Table 4.2; Summary of results of rational expectations tests against month-on-month turnover realisations. Statistics and details of the models can be found in appendix I.

Test	*Reject RE or accept*	*Reason rejection*
3b Unbiasedness	accept	
4 Efficiency	reject	Expectation errors are not independent of lagged values of turnover development
5a Orthogonality	reject	Expectation errors can be predicted using other survey variables and lagged turnover variables
5b prediction model	reject	Expectations can be improved using readily available data such as lagged turnover, other survey variables and exogenous macro-economic variables

Overall, for the month-on-month changes, expectations are not consistent with the rational expectations hypothesis, as all but one of the conditions for rationality are violated. Though expectations are unbiased (condition 3b), expectations are not efficient (condition 4) as some lagged turnover variables are significant in predicting forecast errors. The orthogonality condition (5a and 5b) is not met either. It is possible both to predict errors in expectations and to enhance the turnover predictions of the expectations by using some readily available additional variables, clear violations of rational expectations Most important is that the information contained in past turnover development and in additional components of the business survey is not fully exploited in forming production expectations. This

indicates that agents do not efficiently exploit the information which they have readily available. As far as these results are concerned, adaptive expectations seems to be the most plausible of the expectation formation mechanisms tested here.

B. Testing the expectation formation mechanisms assuming that the expectations correspond to the change in turnover in the next three months compared to the last three (TOma3FL).

1. adaptive $PE_{t+3\|t}$	R^2: 0.178/0.239		**2. extrapolative $PE_{t+3\|t}$**	R^2: 0.009/0.012	
χ^2 =1814(2)	% correct: 72.4		χ^2 =94(1)	% correct: 58	
Exogenous	Coefficient	Wald	Exogenous	Coefficient	Wald
C	1.16 (0.000)	1227.8	C	0.292 (0.000)	219
$TOma3L_t$	0.192 (0.000)	14.3	$TOma3L_t$	0.462 (0.000)	76.1
$PE_{t\|t-1}$	1.870 (0.000)	1580.4			

Table 4.3; Summary of results of rational expectations tests against the turnover development over three-month periods($TOma3FL_t$). Statistics and details of the models can be found in appendix I.

Test	*Reject RE or accept*	*Reason rejection*
3b Unbiasedness	reject	higher chance of prediction error when expecting an increase. (optimism)
4 Efficiency	reject	Expectation errors are not independent of lagged values of turnover development
5a Orthogonality	reject	Expectation errors can be predicted using other survey variables and lagged turnover variables
5b prediction model	reject	Expectations can be improved using readily available data such as lagged turnover, other survey variables and exogenous macro-economic variables

The same conclusions as for the month-on-month turnover change hold for the three-month turnover development. The conditions for rational expectations are not met, now including unbiasedness. The chance of a forecast error is higher when an increase is expected. Adaptive expectations seems to be the most plausible mechanism of the three tested here. Interesting is that the tendency of new orders inflow and the past turnover development can be used to improve the prediction of turnover development in the coming three months.

C. Testing the expectations formation mechanisms assuming that the expectations correspond to the change in turnover in the next six months compared to the last six (TOma6FL).

1. adaptive $PE_{t+3\|t}$	R^2: 0.178/0.238		**2. extrapolative $PE_{t+3\|t}$**	R^2: 0.010/0.013	
χ^2 =1800(2)	% correct: 72.4		χ^2 =105(1)	% correct: 58.1	
Exogenous	Coefficient	Wald	Exogenous	Coefficient	Wald
C	1.12 (0.000)	1231.0	C	0.306 (0.000)	236.4
$TOma6L_t$	0.212 (0.000)	13.7	$TOma6L_t$	0.530 (0.000)	91.4
PE_{t-1}	1.865 (0.000)	1556.3			

Table 4.4; Summary of results of rational expectations tests against the turnover development over six-month periods($TOma6FL_t$). Statistics and details of the models can be found in appendix I.

Test	*Reject RE or accept*	*Reason rejection*
3b Unbiasedness	reject	higher chance of prediction error when expecting an increase.
4 Efficiency	reject	Expectation errors are not independent of lagged values of turnover development
5a Orthogonality	reject	Expectation errors can be predicted using other survey variables and lagged turnover variables
5b prediction model	reject	Expectations can be improved using readily available data such as lagged turnover, other survey variables

Here, the pattern is the same as in the previous two cases. Tested against the turnover development over a six month period, expectations cannot be said to satisfy the conditions of the rational expectations hypothesis. Expectations are neither unbiased nor efficient. Past turnover development and, again, the tendency of new orders can be used to improve the expectation of turnover development. The adaptive expectations mechanism possesses the best fit in this case as well.

Another option when analyzing survey responses is to evaluate respondents' expectations against their own assessment of realisations. The argument is that the survey realisations probably most closely resemble the subject of their expectations, how they actually experience the realisations. This somewhat evades the problem, as then the question should become whether respondents' observations are rational. However, this approach is useful here as it is uncertain whether the turnover used in this study accurately reflects production development as experienced by the respondents. Also, the results are quite similar to those based on comparisons with actual turnover development. The respondents assessment of production realisations in the coming three months was approximated by the average value in the coming three months of the answers to the survey question on current production levels (PAma3F).

D. Testing the expectation formation mechanism assuming that the expectations correspond to the three-month average of respondents' own future Survey assessments of the development of turnover (PAma3F).

1. adaptive $PE_{t+3\|t}$	R^2: 0.194/0.260		**2. extrapolative $PE_{t+3\|t}$**	R^2: 0.015/0.021	
χ^2 =1425(1)	correct: 73.3		χ^2 =108(1)	% correct: 55.1	
Exogenous	Coefficient	Wald	Exogenous	Coefficient	Wald
C	1.12 (0.000)	879	C	0.580 (0.000)	171.0
$PAma3F_{t-1}$	n.s	0	$PAma3F_{t-1}$	0.545 (0.000)	105.7
PE_{t-1}	1.99 (0.000)	1269			

Table 4.5; Summary of results of rational expectations tests based the expectations correspond to the three-month average of respondents' own future Survey assessments of the development of turnover (PAma3F). Statistics and details of the models can be found in appendix I.

Test	*Reject RE or accept*	*Reason rejection*
3b Unbiasedness	reject	higher chance of prediction error when expecting an increase.
4 Efficiency	reject	Expectation errors are weakly predictable with lagged values of turnover development
5a Orthogonality	reject	Expectation errors can be predicted using other survey variables and lagged turnover variables
5b prediction model	reject	Expectations can be somewhat improved using other survey variable

All rational expectations criteria are rejected. Therefore, respondent are unable to form rational expectations of the future, tested against both actual realisations and their own future assessment of current realisations.

It can be concluded that producers do not form expectations according to the criteria for rational expectations as far as future production is concerned. When evaluating the importance of this, one should keep in mind that producers are supposed to have intimate knowledge of their business conditions, and have at least some control over production levels in the near future. Apart from failing the unbiasedness criterion, or the fact that errors are not independent of lagged turnover variables, the most serious failure is that adding information which is readily available to firms markedly increases the predictive power of expectations. One could argue that the turnover measures used in this study do not accurately reflect production developments as experienced by producers. However, their expectations are not rational either when compared with their own future assessments of current turnover realisations.

To see whether producers expectations can be described as bounded rational, two tests were devised. Here, bounded rationality is made operational, perhaps rather crudely, by assuming that under this hypothesis expectations are formed using simple rules or models, possibly based on past experience. This suggests that it should be possible to model, or predict, expectations using simple methods of forecasting turnover. This is one test. The other is to see whether expectations are at least equal to, or better than, these simple methods in predicting turnover development.

A number of simple methods of predicting turnover development were devised. First, there are two types of naïve predictions. One is the constant-only model, which assumes a fixed probability of observing an increase or a decrease, dependent on the proportions in the sample. This is comparable to taking the sample average as prediction/expectation. The other is a simple autoregressive model, taking last period's realisation as prediction. Thus, if the previous period a decrease was observed, the expectation will be a decrease as well (or an increase in case of contrarian expectations). This can be done using last month's month-on-month or year-on-year change as a predictor. A slightly more complicated method is to use realisations over a longer period in the prediction, for example an AR(3) model or the average development over the past three or six months. An autoregressive formulation can also be achieved by comparing the number of "increase" and "decrease" months in the past six months, using the NOyoyL6 and NOyoyF6 variables. Though entered here in an econometric model, these are all fairly simple prediction models which might be "learnable" in practice. If indications of their use can be found here, this could point to producers' expectations being boundedly rational. First, it is tested how predictions of production expectations for different measures of turnover development compare to some simple prediction models.

Table 4.6; Predictions for turnover change of different simple prediction models compared with those of production expectations (PE_t). TOmom = relative month turnover change, TOma3FL is change in turnover past three months compared to coming 3 months, TOma6FL the same but for a 6 month period.

	$TOmom_t$		$TOma3FL_t$		$TOma6FL_t$	
	Cox&Snell/ Nagelkerke R^2	% correct	Cox&Snell/ Nagelkerke R^2	% correct	Cox&Snell/ Nagelkerke R^2	% correct
Constant	-	51.2	-	50.2	-	51.8
AR(1) yoy change	-	-	0.006/0.008	52.9	0.002/0.003	52.7
AR(1) mom change	0.015/0.020	55	0.001/0.001	51.7	0.002/0.002	52.6
AR(3)[1]	0.016/0.022	55.4	0.097/0.129	65.8	0.077/0.103	64.1
AVNODPL6	0.143/0.190	64.8	0.002/0.002	51.9	0.001/0.001	52
AVNODYL6	0.086/0.115	62.7	0.004/0.005	52.9	0.008/0.011	54.7
$PE_{t+3\|t}$[2]	0.024/0.032	57.8	0.06/0.08	62.1	0.052/0.069	60.9

1. For TOma3FL, TOma3L (change in turnover compared to the average of the last 3 months) was used as autoregressive AR(3) variable. For TOma6FL, TOma6L was used. 2. In the models for all three dependent variables, the expectations ($PE_{t+3|t}$) were significant (0.000 level) and had a positive coefficient, an expected increase corresponding with an actual increase.

For all measures of turnover development, there is a simple method which dominates production expectations in predicting turnover changes, therefore these results do not support bounded rationality in production expectations. In the case of turnover development over the coming three or six months, the development compared to the average of the past three or six months is a better guide, whilst for the month-on-month turnover change, the difference in the past six months between months with increasing turnover and decreasing turnover has predictive value. On the whole, expectations perform better than the very simple methods of predicting turnover, but worse than some slightly more complicated autoregressive methods. Though this does not support the bounded rationality hypothesis, based on these results it cannot be completely rejected either. Expectations are clearly significant in predicting turnover development, but do not use all information which is available in past turnover development. Also, the results in the accompanying report [Van Ruth (2006)] showed that expectations contain information not present in pure autoregressive-models.

The other approach for studying the validity of the bounded rationality hypothesis is to test whether these simple predictors of turnover development can be used to

predict expectations. This would be a clear indication that they are used in forming expectations. These results are then compared to using last period's expectations as predictor, a test for persistence in expectations. To see whether expectations are not as much influenced by the past, but as should be expected by the future, measures of future realisations of turnover are tested as predictors as well. In the three tables below, the results for the three different measures of turnover development are presented.

Table 4.7; Production expectations explained by different simple models of month-on-month turnover change, compared to a model with lagged production expectations.

Explanatory variable for $PE_{t+1\|t}$	*Cox&Snell/ Nagelkerke* R^2	*% correct*	*Significance /sign*
T (TOmom$_t$)	0.018/0.025	58.9	0.000/+
AR(1) (TOmom$_{t-1}$)	0.001/0.002	57.5	0.000/+
AR(3)	0.026/0.034	60.2	0.000/+
t+1 (TOmom$_{t+1}$)	0.002/0.003	58.3	0.000/+
NOmomL6	0.003/0.005	57.9	0.000/+
NOmomF6	0.002/0.003	58.5	0.000/+
PE$_{t\|t-1}$	0.176/0.236	72.4	0.000/+
constant	-	57.4	0.000/+

Table 4.8; Production expectations explained by different simple models of turnover change over a six-month period compared to a model with lagged production expectations

Explanatory variable for $PE_{t+1\|t}$	*Cox&Snell/ Nagelkerke* R^2	*% correct*	*Significance /sign*
T (TOma6FL$_t$)	0.037/0.049	62.7	0.000/+
AR (TOma6L$_{-t}$)	0.022/0.029	57.6	0.000/+
t+1 (TOma6F$_t$)	0.001/0.001	57.4	0.004/+
PE$_{t\|t-1}$	0.176/0.236	72.4	0.000/+
constant	-	57.4	0.000/+

Table 4.9; Production expectations explained by different simple models of turnover change over a three-month period, compared to a model with lagged production expectations

Explanatory variable for $PE_{t+1\|t}$	*Cox&Snell/ Nagelkerke* R^2	*% correct*	*Significance /sign*
T (TOma3FL$_t$)	0.000/0.000	57.5	n.s./
AR (TOma3L$_{-t}$)	0.026/0.035	58	0.000/+
t+1 (TOma3F$_t$)	0.005/0.007	57.6	0.005/+
PE$_{t\|t-1}$	0.176/0.236	72.4	0.000/+
constant	-	57.4	0.000/+

Almost all these variables are significant in explaining expectations, though the improvement on the benchmark constant-only model is usually small. Especially the expanded autoregressive model for month-on-month turnover changes and the development over a six month(TOma6FL) period are significant in explaining expectations. The one-period lagged value of expectations is the best predictor of expectations though. This is possibly an indication of strong persistence in expectations, but is also consistent with expectations being determined by medium-term developments in turnover. This warrants less frequent changes in expectations, as the longer-term outlook is bound to change less than single month production realisations. On the whole, there is some evidence here of these simple methods being used in forming expectations, but not much. This does not support the bounded rationality hypothesis. Also interesting is the fact that both past and future turnover realisations are significant in explaining expectations. This points to expectations containing both a forward and a backward-looking component, this will be further investigated in section 4.3.3.

4.3 Survey dynamics and interactions

4.3.1 Influences on expectations and interactions within the Survey

It is an interesting question how the appraisals of firms of different aspects of business conditions, as polled in the survey, influence each other and whether it is possible to gain additional information from this interaction. A start is to look at the contemporary relationship between the production expectations and the other survey components. After elimination of the non-significant variables in a logit-analysis, the following model remained:

Interactions between production expectations($PE_{t+3|t}$*) and other survey variables:*

Dependent variable: $\mathbf{PE_{t+3|t}}$

χ^2=333.5(3), R^2=0.345/0.467, % correct = 79.2.

Variable	Coefficient (significance)	wald
Constant	**2.386 (0.000)**	105.7
$\mathbf{PA_{t\|t}}$	**0.703 (0.010)**	6.7
$\mathbf{Price_{t+1|t}}$	**1.425 (0.000)**	57.4
$\mathbf{ORDERTENDEN_t}$	**2.189 (0.000)**	

A strong connection exists between different components of the Manufacturing Business Survey. An expected increase in production ($PE_{t+3|t}$) usually is accompanied by an expected increase in sales prices ($Price_{t+1|t}$), an increase in the value of new orders ($ORDERTENDEN_t$), and to a lesser extent with an improvement in current conditions ($PA_{t|t}$). These relationships are consistent, an expected increase in production should be coincident with, or preceded by, an increase in new orders. The simultaneously expected price rise is interesting as well, indicating either that firms expect to raise prices when demand increases, or that rising prices elicit an increase in production. When a lag of production expectations and a turnover variable are entered in the model, the assessment of current conditions ($PA_{t|t}$) is no longer significant. Price expectations and order inflow remain strongly significant, suggesting a strong relationship with production expectations. The results are broadly the same when a turnover variable (TOma6FL, turnover development in the coming six months compared to the last six) is added, as well as a number of exogenous variables. The latter were entered with lags such that realisations could have been obtained from publications of Statistics Netherlands or from the press.

Broad model for explaining production expectations ($PE_{t+3|t}$*)*

Dependent variable: $\mathbf{PE_{t+3|t}}$

χ^2=295.8(4), R^2=0.384/0.519, % correct = 79.0

Variable	coefficient(significance)	wald
Constant	**2.567 (0.000)**	95.9
$\mathbf{PE_{t\|t-1}}$	**1.690 (0.000)**	56.9
$\mathbf{Price_{t+1|t}}$	**1.304 (0.000)**	34.8
$\mathbf{ORDERTENDEN_t}$	**1.836 (0.000)**	49.8
TOma6FL	**1.308 (0.001)**	10.8

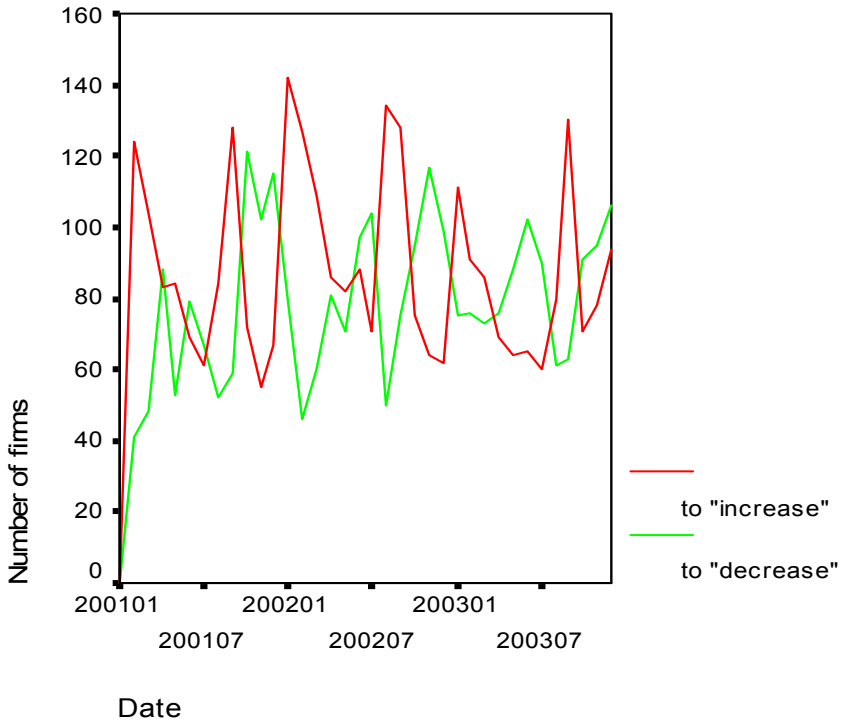
Exogenous variables entered and not significant: Real consumption, Industrial production, Exports, Producer confidence, Consumer confidence, all in year-on-year changes.

The lagged value of expectations was mainly included to filter out spurious correlations due to general co movement in variables under influence of general economic conditions. Due to the large amount of persistence in expectations, the influence of (past) trends will largely be captured by this variable. This means that other explanatory variables which remain significant, have a clear relationship with expectations other than by a common direction of development. The results show that production expectations are not solely determined by turnover developments, future or past. Developments in business conditions as characterised by price developments (expected, PRICE) and the value of order inflow(ORDERTENDEN) seem to be more important, as all the exogenous variables were non-significant. This could to indicate that respondents base their expectations mainly on the outlook for their own business, and that external news on general economic conditions has little influence on this. Carroll [2003] has argued that respondents need some time to digest news, and that therefore its influence will only gradually diffuse into expectations. Single month realisations might therefore be too erratic to be a satisfactory representation of the influence of macro-economic news. Three-month moving averages were constructed for all the exogenous macro-economic indicators, and lagged values of these were entered in the model. Again, these variables had no predictive power for expectations, conforming the irrelevance of external news for Survey expectations.

4.3.2 Changes in expectations

A different aspect of the expectations formation process which is interesting, is what causes expectations to change. Here, it will be studied what causes expectations to change to either an expected "increase" or to an expected "decrease" in production. The simple answer is of course a past or expected change in production. However, as has become clear, expectations are only partly determined by short-term turnover changes. Longer-term developments in business conditions, as represented by judgements from the Business Survey and medium-term turnover development, have much influence. Changes herein should be linked to changing production expectations. Apart from this, there is the error-learning mechanism, which states that previous errors in expectations should influence changes in expectations. A dummy variable tracking changes in production expectations was created, taking the value -1 for a change to "decrease", 0 for a change to "increase" and 1 for no change. (change is compared to the previous month), see fig. 4.1.

Fig. 4.1; Monthly number of switches to expected increasing production in the coming three months and to expected decreasing production.



The number of changes in expectations is rather volatile. A seasonal pattern is visible, especially in the number of changes to an expected increase. On average, disregarding seasonal influences, the number of firms switching to an expected increase in production seems to be roughly constant over this period. On the other

hand, the number of firms switching to an expected decrease in production shows a rising trend.

For the other variables from the Business Survey, a similar switching-variable was created, but also additional variables tracking changes compared to the answers given respectively six and twelve months before. This was done to see whether a change in production expectations is preceded by a change of opinion on some other aspect of business conditions. This proved not to be the case, only contemporary effects were found to be significant. Turnover variables were also not important in explaining *changes* in expectations.

Table 4.10; Results logit-model changes in production expectations predicted by simultaneous changes in responses to other Survey components

Change of expectations to:	*Explanatory variable*	*Coefficient*	*Wald*
Decrease	*Price to "decrease"*	***0.918 (0.000)***	***61.5***
	Price to "increase"	***0.684 (0.000)***	***31.5***
	$PA_{t\|t}$ to "decrease"	***0.522 (0.000)***	***41.8***
	$PA_{t\|t}$ to "increase"	0.160 (0.092)	2.8
	Stocks to "small"	***1.188 (0.000)***	***163.5***
	Stocks to "large"	-0.671 (0.002)	9.5
	ORDERSIN to "small"	***1.375 (0.000)***	***322.6***
	ORDERSIN to "large"	0.075 (0.468)	0.5
Increase	Price to "decrease"	0.074 (0.602)	0.3
	Price to "increase"	***0.778 (0.000)***	***50.0***
	$PA_{t\|t}$ to "decrease"	***1.171 (0.000)***	***239.0***
	$PA_{t\|t}$ to "increase"	0.233 (0.003)	8.5
	Stocks to "small"	-0.145 (0.248)	1.3
	Stocks to "large"	***0.759 (0.000)***	***44.0***
	ORDERSIN to "small"	***0.522 (0.000)***	***35.0***
	ORDERSIN to "large"	***1.270 (0.000)***	***303.0***

Cox & Snell/Nagelkerke R^2: 0.180/0.209, χ^2 = 1874 (16) (0.000).

Changes in production expectations are generally accompanied by a change in opinion on a number of different aspects of business conditions, such as current production development, order inflow, prices and stocks. When expectations on production change to an expected decrease, order inflow switches to "small" and the expected price development switches to a decrease. This indicates weakening demand. At the same time, the assessment of current production changes to a "decrease", while the assessment of stocks changes to "small". The developments in the assessment of stocks is somewhat counterintuitive, with smaller stocks connected to worsening business conditions and larger stocks to more a more positive outlook. It seems that stocks are built up when demand is expected to be strong, and run down when the outlook is negative. Thus, changes in expectations, and Business Survey answers in general, seem to be more connected to changes in the general outlook for the firm than to (short-term) fluctuations in production.

The results are actually slightly more complex than suggested in the preceding analysis. In most cases, a change in expectations in one way is accompanied by changes in the other variables to both "increasing" and "decreasing". For example, in the case of a change to an expected increase in production, order inflow assessment changes to both "small" and "large". But in almost all these case, the matching answer is far more significant (as measured by the Wald statistic) that the illogical option. One explanation might be that some respondents tend to be less than conscientious when completing their Surveys.

Apart from (perceived) changes in business conditions, it seems logical that there is some link between turnover developments and changes in production expectations. As mentioned before, changes in turnover were not significant in explaining changes in expectations. Another possibility is that when expectations are proved wrong, they might change. This constitutes an error-learning mechanism, where changes in expectations depend on mismatches between expectations and realisations in earlier periods. A number of variables were created which gauged agreements and deviations between production expectations and different measures of turnover development (TOmaFL6, TOmaFL3, TOmom). Only mismatches in the previous month between production expectations and the development of turnover over a twelve month period (TOmaFL6) had predictive power for changes in production expectations. Mismatches with shorter-term turnover variables, or other lags of expectations errors were not significant.

Table 4.11; Estimation results error-learning model of changes in production expectations and mismatches in the previous month between expectations and turnover realisations measured by the development over the next six months compared to the previous six (TOmaFL6). Pessimism= an expected decrease is accompanied by a realised increase, optimism = an expected increase is accompanied by a realised decrease.

Change of expectations to:	*Error on turnover development ($TOma6FL_{t-1}$) in the pervious month*	*Coefficient*	*Wald*
$Decrease_t$	*$Pessimism_{t-1}$*	*0.178 (0.036)*	*4.4*
	$Optimism_{t-1}$	*0.289 (0.000)*	*20.8*
$Increase_t$	*$Pessimism_{t-1}$*	0.583 (0.000)	63.5
	$Optimism_{t-1}$	*0.018 (0.776)*	*0.10*

Cox & Snell/Nagelkerke R^2: 0.010/0.012, χ^2 = 87.7 (4) (0.000).

The direction of the relation is as expected. If respondents were too optimistic in the previous month, a change to an expected decrease is more likely, and vice versa. It is interesting that only deviations from average turnover development over longer-term periods were significant. This ties in quite well with earlier results which point to a strong link between expectations and general business conditions. In a combined model with changes in responses to other Survey component, errors in expectations remain significant.

Table 4.12; Combined logit-model error-learning (errors on realisations on 12-month turnover development TOmaFL6) and changes in responses to other components of the Business Survey.

Change of expectations to:	*Explanatory variable*	*Coefficient*	*Wald*
Decrease	*Price to "decrease"*	*0.839 (0.000)*	*44.5*
	Price to "increase"	*0.547 (0.000)*	*17.6*
	$PA_{t\|t}$ to "decrease"	*0.415 (0.000)*	*22.4*
	$PA_{t\|t}$ to "increase"	0.127 (0.202)	1.6
	Stocks to "small"	*1.130 (0.000)*	*129.5*
	Stocks to "large"	*-0.798 (0.001)*	*10.9*
	ORDERSIN to "small"	*1.288 (0.000)*	*244.6*
	ORDERSIN to "large"	-0.005 (0.963)	0.02
	$Pessimism_{t-1}$	0.181 (0.055)	3.7
	$Optimism_{t-1}$	0.319 (0.000)	20.1
Increase	Price to "decrease"	0.016 (0.916)	0.011
	Price to "increase"	*0.706 (0.000)*	*36.2*
	$PA_{t\|t}$ to "decrease"	*1.089 (0.000)*	*176.7*
	$PA_{t\|t}$ to "increase"	0.156 (0.072)	3.2
	Stocks to "small"	-0.127 (0.339)	0.9
	Stocks to "large"	*0.645 (0.000)*	*27.0*
	ORDERSIN to "small"	*0.441 (0.000)*	*21.3*
	ORDERSIN to "large"	*1.148 (0.000)*	*210.6*
	$Pessimism_{t-1}$	*0.606 (0.000)*	*55.7*
	$Optimism_{t-1}$	-0.003 (0.962)	0.002

Cox & Snell/Nagelkerke R^2: 0.164/0.190, χ^2 = 1400 (20) (0.000).

A turnover variable was included as well, to represent the influence of actual realisations on expectations. The turnover variable that best explained changes in expectations was lagged month-on-month turnover change ($TOmom_t$). Unlike what one would expect, a negative turnover change means that a change to an expected increase is more likely, and a positive realisation a change to expected decreasing production. These results suggest a certain seasonal component in the expectations,

as month-on-month turnover changes are largely determined by seasonal patterns, whit alternating decreases/increases. Interestingly, future turnover realisations proved to be of no influence on changes in expectations.

4.3.3 Forward vs. Backward looking expectations

It is also interesting to study the relative importance of the past and the future on production expectations. Whether expectations are purely forward looking, purely backward looking, or something in between is important both from a theoretical and a practical point of view. Models for expectations were estimated containing respectively only future turnover development variables, only past developments and both future and past turnover development. Future turnover realisations are bound to be an imperfect measure of the influence of the future on expectations. At the time of expectation formation, past turnover realisations are known, unlike the future ones. Future turnover realisations might be affected by unexpected shocks and random fluctuations. Combining past and future turnover results in a model explaining production expectations will therefore result in an overstatement of the influence of the past and an understatement of the influence of the future. To test for this, lagged and future production expectations ($PE_{t|t-1}$/$PE_{t+2|t+1}$) and production assessments (PAma3L /PAma3F) were also used to explain production expectations. These are probably more representative of how the respondent experiences the past and future, from which the random and irrelevant events have been filtered. It is important to note here that the aim in this section is not to study how well expectations correspond to future and past turnover developments, but to test to what measure perceived future and past developments influence expectations. The results can be found in table 4.13.

Table 4.13; Models for influence on production expectations of past and future developments, as represented by turnover and opinions form the business survey.

Explanatory variable	*Representing Past/ future*	*Wald*	χ^2	*Cox&Snell/ Nagelkerke* R^2	*% correct*
TOma3F	Future	7.9	16.4	0.002/0.002	57.6
TOma3L	Past	76	93,8	0.009/0.012	58
TOma6F	Future	3.1	6	0.001/0.001	58.8
TOma6L	Past	91.3	104.8	0.01/0.013	58.1
TOma3L +TOma3F	Both	47.1/23.2	210	0.02/0.026	59.9
TOma6L + TOma6F	Both	102.8/39	130	0.014/0.019	59.6
PAma3F	Future	484	697	0.087/0.116	57.3
PAma3L	Past	106	108	0.015/0.021	55.1
PAma3F + PAma3L	Both	339/36	533	0.09/0.12	59.5
$\mathbf{PE_{t+2\|t+1}}$	Future	1619	1792	0.176/0.237	72.4
$\mathbf{PE_{t\|t-1}}$	Past	1619	1792	0.176/0.236	72.4
$\mathbf{PE_{t+2\|t+1}}$ + $\mathbf{PE_{t\|t-1}}$	Both	1018/ 1049	2676	0.281/0.378	73.7

Expectations seem to be determined by a mix of future and past developments, with varying importance depending on which measure of the future/past is considered. For the turnover variables, models with only future turnover developments as explanatory variable variables perform worse than those with only past developments. Models containing both future and past developments give a superior fit, but in these past developments again have the largest influence on expectations. If one uses past and future assessments of current production development (PA_i) to explain expectations, the reverse is true and future realisations have more influence. The analysis using lagged and future expectations complicates matters even more, as in this case the past and the future seem to have equal influence on expectations. A first conclusion is that using future turnover realisations leads to an underestimation of the influence of the future on expectations, and therefore to an unwarranted classification of expectations as backward-looking. When using proxies (from the Survey) for future developments as experienced by the respondents, the influence of future developments strongly increases. This corroborates the results of the earlier

study [Van Ruth (2006)] which found that expectations are at the least partly determined by medium-term developments in business conditions, which are linked to future and past developments. It seems best to describe expectations as both forward- and backward looking.

To briefly summarize the results of this section: There is a clear link between production expectations, price expectations and order inflow. An expected increase in production is generally accompanied by an increase in order inflow and in expected sales prices. Changes in production expectations are likely to be accompanied by matching changes in these variables. The assessments of stock levels and current production development have some influence as well. On the whole, the close link between production expectations and these other components of the Survey indicates that expectations are more influenced by developments in business conditions that in short-term turnover developments. This is corroborated by the fact that in an error-learning context, only mismatches between longer-term turnover development and expectations are of influence on changes in expectations. Another interesting result is the correspondence between price expectations and production expectations. This is an indication that Dutch firms operate under circumstances of imperfect competition[See also König et al. and Low et al.]. A final result is that Survey expectations cannot be classified as either forward- or backward-looking, but contain both forward- and backward-looking components.

5. Discussion and Conclusions

A general conclusion here could be that expectations are rather complex. As Business Survey outcomes are widely used in economic analysis and in reporting on the business cycle, it is important to know how well these actually gauge the developments in business conditions. On a more theoretical level, expectations play a large roll in many economic theories. How expectations are formed and what influences them is crucially important for these theories. It was possible here to contribute to understanding of these issues because of the availability of a dataset containing firms' responses to the monthly Business Survey and reported monthly turnover realizations, linked at the firm-level. This micro-data approach made it possible to confront expectations with the corresponding actual realizations. Throughout this study, the logit-model was used to model the interactions. The dependent variable is not explicitly modeled, but the probability of observing a certain value of the dependent variable as function of the explanatory variables.

At the same time it was possible to study what other factors besides turnover development influence expectations. For a start, there are the other components of the business survey which inquire after other aspects of business conditions, for example the tendency of current production and sales-price expectations. Also, it is sometimes suggested that expectations are (mainly) influenced by external news, for example on macro-economic conditions and other environmental factors. Here, the influence of exogenous variables on individual firms' expectations was tested. Besides these more practical aspects, a number of proposed expectation formation processes, e.g. rational expectations, were tested as well,.

One part of this study was concerned with the interactions between the different aspects of business conditions as represented by different questions of the Business Survey and some investigation into the dynamism of expectations. This showed a strong positive relationship between production expectations, order inflow and price development expectations. Production was almost only expected to increase when order inflow increased, and this was usually connected to an expected sales-price increase as well. The influence of exogenous variables on expectations was tested as well. News was supposed to be represented by variables based on macro-economic realisations as reported by Statistic Netherlands and the press. When entered in models explaining expectations, these were shown to be of little or no influence on expectations and added little to turnover prediction. It can be concluded that expectations are mainly formed on the basis of direct business conditions of the firm, and not influenced by external news.

The previous results were confirmed by investigating what causes production expectations to change. Interestingly, changes in turnover were not very important in explaining these switches, but contemporaneous changes in price outlook, order inflow, stock assessment and production assessment were. The probability of a change to an expected decrease (increase) in production was increased when price expectations changes to a decrease (increase) as well, order inflow changed to decrease (increase) and the assessment of stocks changed to "small" ("large"). The connection with production assessment is somewhat unclear. Overall, it seems that for production expectations, general business conditions as characterized by order inflow and price developments are more important than turnover realizations. And when the conditions worsen, stocks are run down, while when the outlook is more positive, stocks are increased. Another factor which could cause changes in expectations is when expectations in previous periods are proved wrong, so-called error-learning mechanisms. This was the case for errors in the previous month in expectations compared to medium-term turnover developments. The influence of these errors was relatively weak though, and errors on shorter-term measures of turnover development were of no influence. On the other hand, the previous month's errors remained significant when combined with the other change variables, thus some form of error-learning is clearly present. All in all it can be said that changes in expectations are strongly connected by (perceived) changes in business conditions.

The most important expectations formation mechanism tested in this study is the rational expectations hypothesis. It was shown that Business Survey expectations do not conform to the standards of this theory. Expectations should not be systematically wrong, and it should not be possible to easily improve upon them with information available at the time of expectation formation. Formal tests of unbiasedness and efficiency rejected the first condition. Furthermore, it was shown that when combining production expectations with other components of the business survey and lagged values of turnover development, the predictions of turnover development were significantly improved. Thus, expectations do not fully exploit all information readily available within the firm at the time of expectation formation. One qualifying remark is in order. This approach is of course actually a double hypothesis test; firstly of rational expectations, but also whether the responses to the Business Survey are a valid representation of expectations. It is very difficult to resolve this, though the assumption that survey responses are an acceptable reflection of expectations seems defendable. After all, firms are explicitly asked for their expectations of future production development. And failing to comply with the standards of the rational expectations hypothesis does not mean that expectations are irrational.

An adaptation of rational expectations is bounded rationality, which states that due to information or time constraints, agents make do with simple rules and experience when making predictions. Thus, production expectations were compared with simple models ("rules") for turnover development. Expectations were better predictors than the simplest models, but there usually was a relatively simple

autoregressive model which outperformed expectations. Also, if expectations are formed using these models/rules, it should be possible to model expectations using these rules as explanatory variables. Though these were clearly significant in explaining expectations, explanatory power was usually relatively weak. Therefore, these results do not give strong support to the concept of bounded rationality, though it cannot be rejected either.

Adaptive and extrapolative formulations were also tested as possible expectation formation mechanisms. Both could not be rejected, but adaptive expectations possessed a much better fit to the data than the extrapolative mechanism. Adaptive expectations means that expectations are formed by confronting past turnover realizations with past expectations. Therefore this confirms the results on the presence of error-learning. Adaptive expectations is essentially a backward looking mechanism, (expected) future realizations have no direct influence. Thus it may seem that expectations are mainly formed on the basis of past experiences. To investigate this, models explaining expectations containing respectively only future turnover realizations, only past turnover realizations and both, were constructed.

The models containing past turnover realizations were much better at explaining expectations than those with future realizations, though future realizations were significant. In combined models, both future and past turnover realizations were significant, though the influence of the first was much weaker. When using measures of past and future based on Survey variables, past and future developments had about equal influence on production expectations. The relatively small influence of future turnover realizations is probably due to some amount of randomness in turnover realizations. Based on these results, expectations can be characterized as containing both a forward and backward looking component. This supports the use of survey variables in forecasting.

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Appendix A; Results of the Rational Expectations Hypothesis tests.

A. Testing Rational Expectations assuming that the expectations correspond to the month-on-month change in turnover ($TOmom_t$):

3b	**RE 1 unbiasedness $TOmom_t$;**		R^2: 0.000/0.000	χ^2 =0.002(1)	% correct: 57.8
	dependent variable : prediction errors				
	Exogenous	Coefficient	Wald		
	C	-0.317 (0.000)	0147.6		
	$PE_{t+3\|t}$	0.002 (0. 967)	0.002		
4	**RE 2 efficiency $TOmom_t$**		R^2: 0.014/0.017	χ^2 =114(4)	
	dependent variable : prediction errors				
	Endogenous	Exogenous	Coefficient	Wald	
	-1 (underestimation)	c	-1.155 (0.000)	1404	
		$TOmom_{t-1}$	-0.006 (0. 000)	37.3	
		$TOmom_{t-2}$	-0.002 (0.011)	6.5	
	0 (overestimation)	c	-0.926 (0.000)	1043	
		$TOmom_{t-1}$	-0.004 (0.000)	43.5	
		$TOmom_{t-2}$	0.000 (0.5462)	0.365	
5a	**RE 3 Orthogonality $TOmom_t$**		R^2: 0.154/0.181	χ^2 =238(8)	
	dependent variable : prediction errors				
	Dependent	Exogenous	Coefficient	Wald	
	(-1) Underprediction	C	-2.122 (0.000)	158.8	
		$TOmom_{t-1}$	-0.006 (0.005)	7.7	
		$TOmom_{t-2}$	-0.004 (0.022)	5.2	
		Price(-)	0..381 (0.008)	7.1	
		ORDERTENDEN(-)	1.271 (0.000)	48.2	
	(0) Overprediction	C	-0.572 (0.000)	31.2	
		$TOmom_{t-1}$	0.003 (0.053)	3.7	
		$TOmom_{t-2}$	0.003 (0.059)	3.6	
		Price(-)	-0.565 (0.001)	11.6	
		ORDERTENDEN(-)	-1.054 (0.000)	44.0	

5b	**RE 3**	**$TOmom_t$ prediction model**	R^2: 0.078/0.105	χ^2 =44.5(8)	% correct: 62.9
	Exogenous	Coefficient	Wald		
	C	-1. 092 (0. 035)	4.4		
	OP	-0.506 (0. 040)	4.2		
	$PE_{t+3\|t}$	0.951 (0.000)	18.8		
	$CVdy_{t-1}$	-0.059 (0. 010)	6.7		
	$Expdy_{t-1}$	-5.117 (0. 047)	4.0		
	$PVdy_{t-1}$	0.052 (0. 019)	5..5		
	$Cocpdy_{t-1}$	-13.7 (0. 056)	3.6		
	$TOmom_{t-1}$	-0.008 (0. 002)	9.8		
	$TOmom_{t-2}$	-0.006 (0. 006)	7.6		

The exogenous variables entered were: OP_t, $ORDERSIN_t$, $ORDERTENDEN_t$, $Price_t$, $ORDERSTOTAL_t$, three lagged values of the firms month-on-month turnover change (TOmom), the previous months consumption growth(real, year-on-year) (Cocpdy), export growth (Expdy), industrial production growth (index), change in producer confidence (PVdy), and change in consumer confidence (CVdy).

B. Testing Rational Expectations assuming that the expectations correspond to the change in turnover in the next three months compared to the last three (TOma3FL).

3b	**RE 1**	**unbiasedness TOma3FL**	R^2: 0.002/0.003	χ^2 =21.4(1)	% correct: 62.1
	Exogenous	Coefficient	Wald		
	C	-0.416 (0.000)	251.7		
	$PE_{t+3\|t}$	0.188 (0.000)	21.4		

4	**RE 2**	**efficiency TOma3FL**		R^2: 0.018/0.021	χ^2 =189(2)
	dependent variable : prediction errors				
	Endogenous	Exogenous	Coefficient	Wald	
	-1 (underestimation)	c	-1.43 (0.000)	2574	
		$TOma3L_t$	0.098 (0. 003)	8.8	
	0 (overestimation)	c	-1.428 (0.000)	1750	
		$TOma3L_t$	-0.863 (0.000)	142	

5a **RE 3** **Orthogonality TOma3FL** R^2: 0.128/0.152 χ^2 =184(8)

dependent variable : prediction errors

Dependent	Exogenous	Coefficient	Wald
(-1) Underprediction	C	-2.566 (0.000)	172.5
	$TOma3L_t$	0.919 (0.000)	20.7
	Price(-)	0.715 (0.000)	19.5
	ORDERTENDEN(-)	0.791 (0. 002)	9.9
	OP(-)	0.473 (0. 053)	3.8
(0) Overprediction	C	-0.664 (0.000)	35.5
	$TOma3L_t$	-0.838 (0.000)	12.9
	Price(-)	-0.488 (0.000)	9.1
	ORDERTENDEN(-)	-0.999 (0.000)	25.2
	OP(-)	0.342 (0. 082)	3.0

5b **RE 3** **TOma3FL prediction model** R^2: 0.138/0.185 χ^2 =116.9(3) % correct: 68.3

Exogenous	Coefficient	Wald
C	0.254 (0. 039)	4.3
$TOma3L_t$	2.140 (0.000)	61.1
$PE_{t+3\|t}$	0.693 (0.000)	19.0
ORDERTENDEN	0.358 (0. 095)	2.8
$Expdy_{t-1}$	2.026 (0. 039)	4.6

The exogenous variables entered were: OP_t, $ORDERSIN_t$, $ORDERTENDEN_t$, $Price_t$, $ORDERSTOTAL_t$, the turnover change compared to the average of the last three months $TOma3L_t$, the previous months consumption growth(real, year-on-year) (Cocpdy), export growth (Expdy), industrial production growth (index), change in producer confidence (PVdy), and change in consumer confidence (CVdy).

C. Testing Rational Expectations assuming that the expectations correspond to the change in turnover in the next six months compared to the last six (TOma6FL).

3b **RE 1** **unbiasedness TOma6FL** R^2: 0.006/0.008 χ^2 =58.2(1) % correct: 60.9

dependent variable : prediction errors

Exogenous	Coefficient	Wald
C	-0.312 (0.000)	131.3
PE_t	0.330 (0.000)	57.7

4 **RE 2 efficiency TOma6FL** R^2: 0.018/0.021 χ^2 =166(2)

dependent variable : prediction errors

Endogenous	Exogenous	Coefficient	Wald
-1 (underestimation)	c	-1.48 (0.000)	2294
	$TOma6L_t$	0.318 (0.000)	27.6
0 (overestimation)	c	-0.913 (0.000)	1343
	$TOma6L_t$	-0.736 (0.000)	94.5

5a **RE 3 Orthogonality TOma6FL** R^2: 0.112/0.132 χ^2 =93.6(2)

dependent variable : prediction errors

Dependent	Exogenous	Coefficient	Wald
(-1) Underprediction	C	-2.167 (0.000)	213.3
	$TOma6L_t$	0.738 (0.000)	15.1
	Price(-)	0.516 (0.000)	13.2
	ORDERTENDEN(-)	0.968 (0.000)	33.3
	$Expdy_{t-1}$	-2.638 (0.000)	9.0
(0) Overprediction	C	-0.562 (0.000)	40.4
	$TOma6L_t$	-0.893 (0.000)	19.0
	Price(-)	-0.403 (0. 005)	8.0
	ORDERTENDEN(-)	-0.811 (0.000)	36.5
	$Expdy_{t-1}$	0.342 (0. 607)	0.3

5b **RE 3 TOma6FL prediction model** R^2: 0.103/0.139 χ^2 =76.0(3) % correct: 65.7

Exogenous	Coefficient	Wald
C	0.377 (0. 014)	6.1
$TOma6L_t$	1.733 (0.000)	36.1
$PE_{t+3\|t}$	0.553 (0. 004)	8.4
ORDERSIN	0.366 (0. 078)	3.1

The exogenous variables entered were: OP_t, $ORDERSIN_t$, $ORDERTENDEN_t$, $Price_t$, $ORDERSTOTAL_t$, the turnover change compared to the average of the last six months $TOma6L_t$ the previous month's consumption growth(real, year-on-year) (Cocpdy), export growth (Expdy), industrial production growth (index), change in producer confidence (PVdy), and change in consumer confidence (CVdy).

D. Testing Rational Expectations assuming that the expectations correspond to the respondents' own future Survey assessments of the development of turnover (PAma3F).

3b	**RE 1**	**unbiasedness** PAma3F	R^2: 0.428/0.572	χ^2 =4293.5(1)		% correct: 83.2
	dependent variable : prediction errors					
	Exogenous	Coefficient	Wald			
	C	1.049 (0.000)	933			
	PE_t	4.076 (0.000)	2056.1			

4	**RE 2**	**efficiency** PAma3F	R^2: 0.002/0.001	χ^2 =9.7(2)	
	dependent variable : prediction errors				
	Endogenous	Exogenous	Coefficient	Wald	
	-1 (underestimation)	c	-3.06 (0.000)	401.7	
		PAma3L	0.318 (0.065)	3.4	
	0 (overestimation)	c	-0.197 (0.000)	16.7	
		PAma3L	-0.160 (0.006)	7.5	

5a	**RE 3**	**Orthogonality** PAma3F	R^2: 0.155/0.197	χ^2 =162.6(8)	
	dependent variable : prediction errors				
	Dependent	Exogenous	Coefficient	Wald	
	(-1) Underprediction	C	-2.564 (0.000)	49.5	
		TOma6L	-0.278 (0.683)	0.2	
		Price(-)	-0.369 (0.387)	0.747	
		ORDERTENDEN(-)	-0.202.968 (0.722)	0.126	
		$PA_{t\|t}$	-0.442 (0.433)	0.615	
	(0) Overprediction	C	0.632 (0.000)	26.3	
		TOma3L	0.449 (0.054)	3.7	
		Price(-)	-1.060 (0.000)	45.2	
		ORDERTENDEN(-)	-0.825 (0.000)	17.9	
		$PA_{t\|t}$	-0.418 (0. 033)	4.6	

5b	**RE 3**	**TOma6FL prediction model**	R^2: 0.115/0.198	χ^2 =111.0(2)	% correct: 84.1
	Exogenous	Coefficient	Wald		
	C	-0.723 (0. 000)	33.6		
	$PE_{t+3\|t}$	1.796 (0. 000)	44.3		
	ORDERSIN	-0.703 (0. 001)	10.9		

The exogenous variables entered were: OP_t, $ORDERSIN_t$, $ORDERTENDEN_t$, $Price_t$, $ORDERSTOTAL_t$, the turnover change compared to the average of the last six months $TOma6L_t$ the previous month's consumption growth(real, year-on-year) (Cocpdy), export growth (Expdy), industrial production growth (index), change in producer confidence (PVdy), and change in consumer confidence (CVdy).

Appendix 2; Logit models

The logit model is used in cases where the dependent variable can only take a limited number of values, for example with qualitative data. The most basic form is a dichotomous dependent variable, which can only take the values 0 and 1, in this study representing “increase” and “decrease”. The aim op the model is to estimate the probability that the dependent assumes the value 1 as function of the explanatory variables:

$$\log\left(\frac{P_i}{1-P_i}\right) = \sum b_k X_{ik} \equiv Z_i \qquad \text{A2-1}$$

P_i = probability dependent variable event i

b_k = regression coefficient

$x_{i,k}$ = exogenous variable

The probability of the dependent variable taking the value 0 is than simply 1-P(Y=1). This way, the influence of the explanatory variables on the probability of P(Y=1) can be studied. The basis of this type of models is in the log-linear models which via probability analysis try to assess the relationship between (qualitative) variables.

The logit model assumes that the probability by a transformation into probability space. Not the 1/0 dependent variable itself is modeled, but the probability of arriving at a certain realization Y(i) as a function of the independent variables X(i). For this to be possible, a certain probability distribution needs to be assumed for the dependent. In this study, the logistics function is used.

$$F(Z) = \frac{e^z}{1+e^z} \qquad \text{A2-2}$$

This results in a smooth, continuous probability distribution for Y(i) and only minimal restrictions. The result is a relatively complex, non-linear relationship between the explanatory variables bX=Z and the resulting probability. The relationship is on the other hand rather logical, with changes in the explanatory variables having relatively little influence on the estimated possibility for the very high and low probability ranges. In the intermediate probability range on the other hand, the estimated probability is much more sensitive to changes in the explanatory

variables. If the odds of either obtaining a 0 or a 1 are about even, it is more logical for the probability to be sensitive to the exogenous variables, than when the chance of obtaining a "1" realization is 95%. This points to a difficulty in interpreting the results of logit models. The influence of a certain variable on the dependent variable cannot be readily deduced from its coefficient in the model. The change in probability which is the result of a certain change in a independent variable X(i) depends on aggregate probability and therefore on its own value and on the value of all other variables in the model. A solution is to evaluate the effects of all variables at their average values. It is however impossible to simply quantify the influence of X(i) on (the probability) of Y(i). It is possible to use the Wald statistic of a variable as a guide for the influence of the corresponding variable in the model. It represents the change in the goodness of fit of the model if the coefficient is set to zero. A small value for the Wald statistic means that the variable contributes relatively little to the model. What is always clear from the estimated coefficients is the direction of the effect of X(i) on the probability Y(i), whether X increases the probability of a "1" or decreases it. This follows from the sign of the coefficient. A positive coefficient means that positive realizations of X(i) are in general more likely to coincide with a "1" realization for Y(i).

The multinomial logit, where the dependent variable has more than two categories, works along the same lines. Only now, all probabilistic are compared to one the probability of obtaining one, reference category. For example the probability of obtaining a 1 compared to a 0, or a 2 compared to a 0. This is how all variables then must be interpreted, as raising (or lowering) the probability of obtaining for example an "increase" (1) against "no change"(0), and the same for "decrease" (2) versus "no change".